

FIG.1

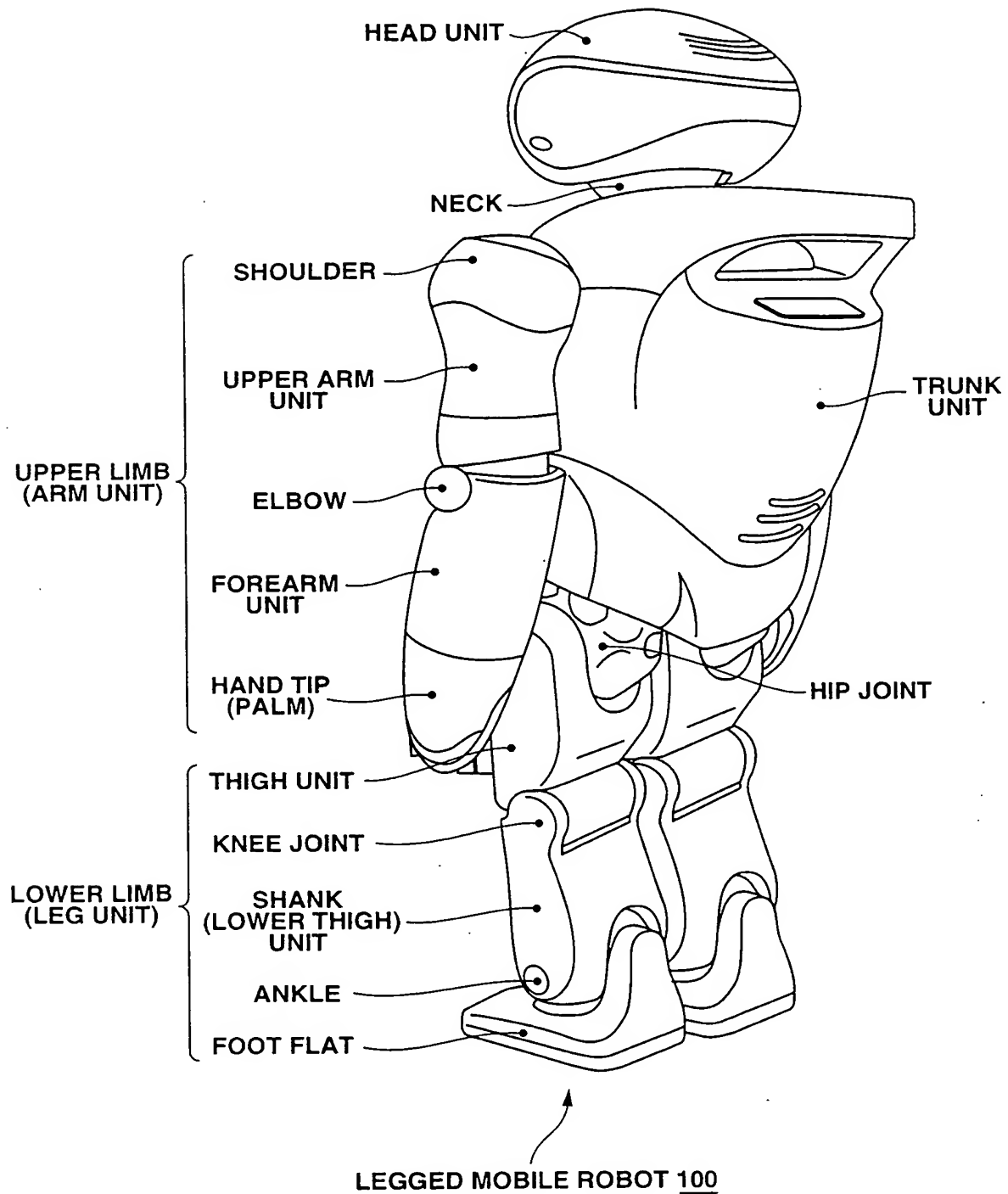


FIG.2

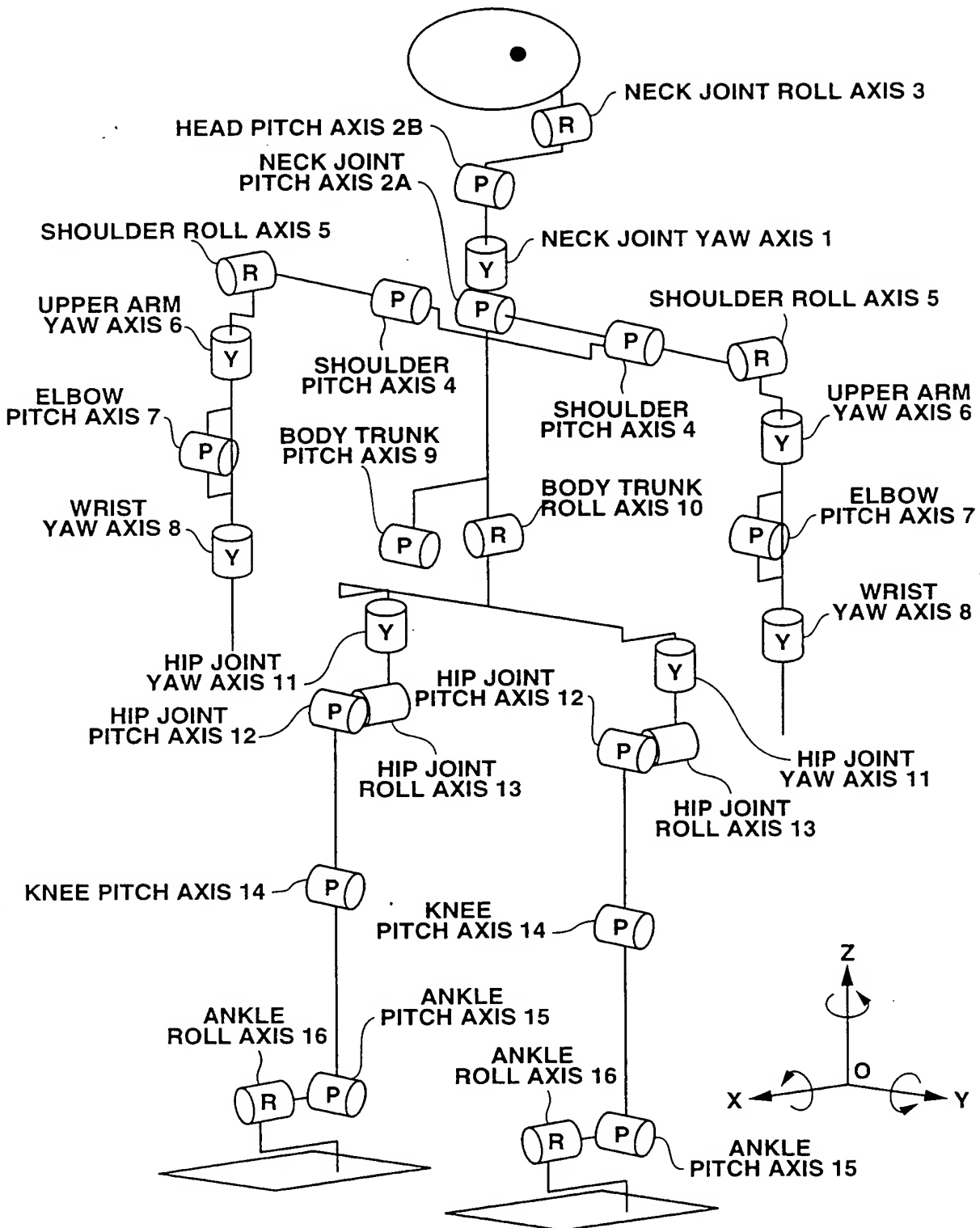


FIG.3

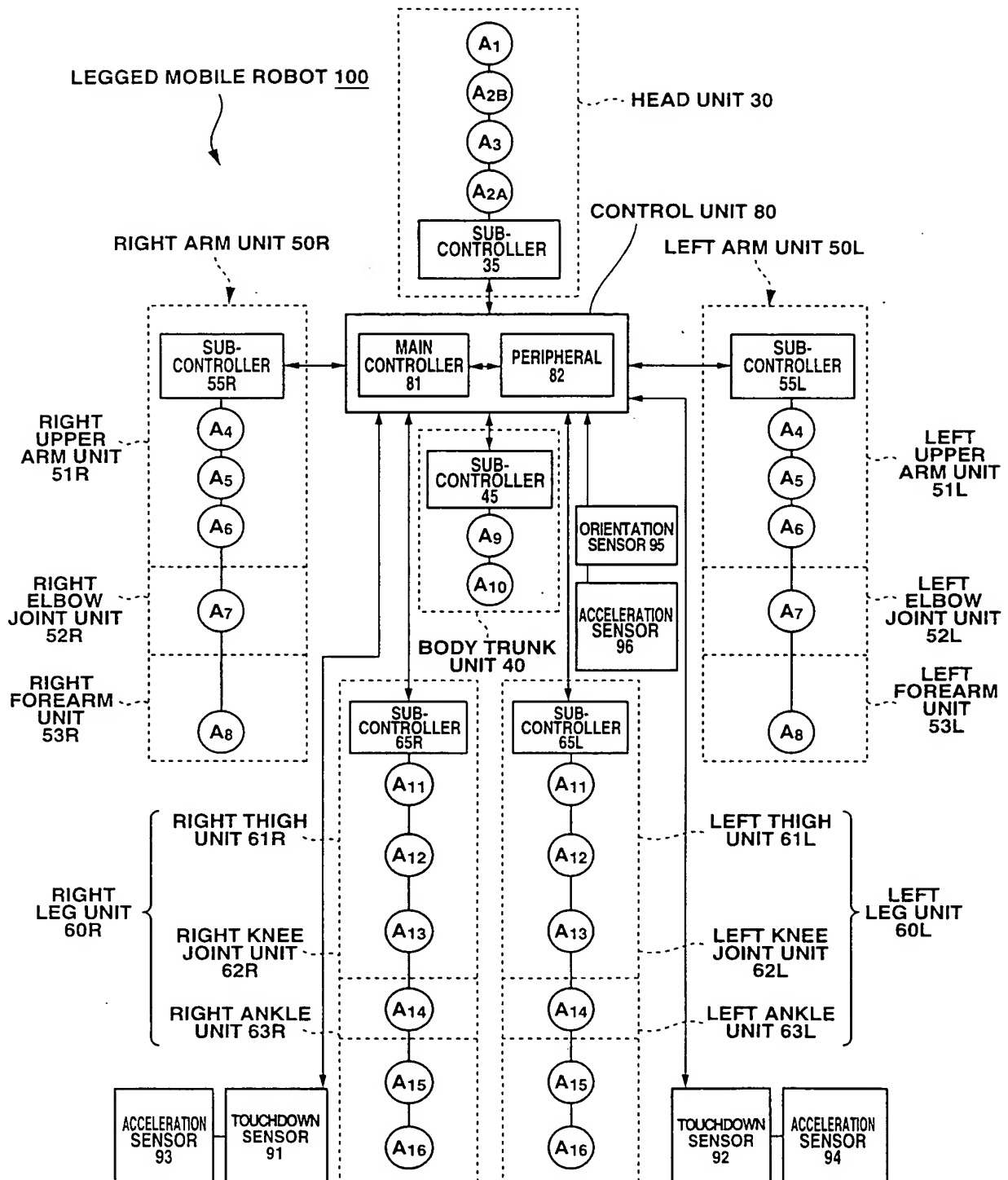
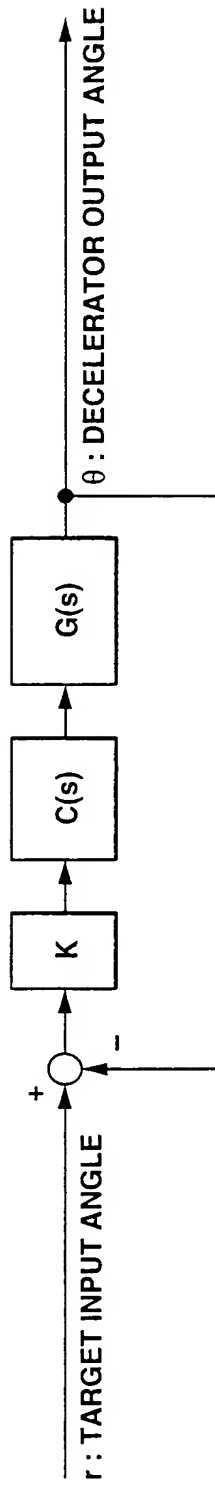


FIG.4



K : SERIAL COMPENSATION GAIN (PROPORTIONAL GAIN)

$C(s)$: TRANSFER FUNCTION OF PHASE COMPENSATION ELEMENT

$G(s)$: MODEL FOR REPRESENTING TRANSFER FUNCTION FOR
MOTOR AND DECELERATOR

FIG.5

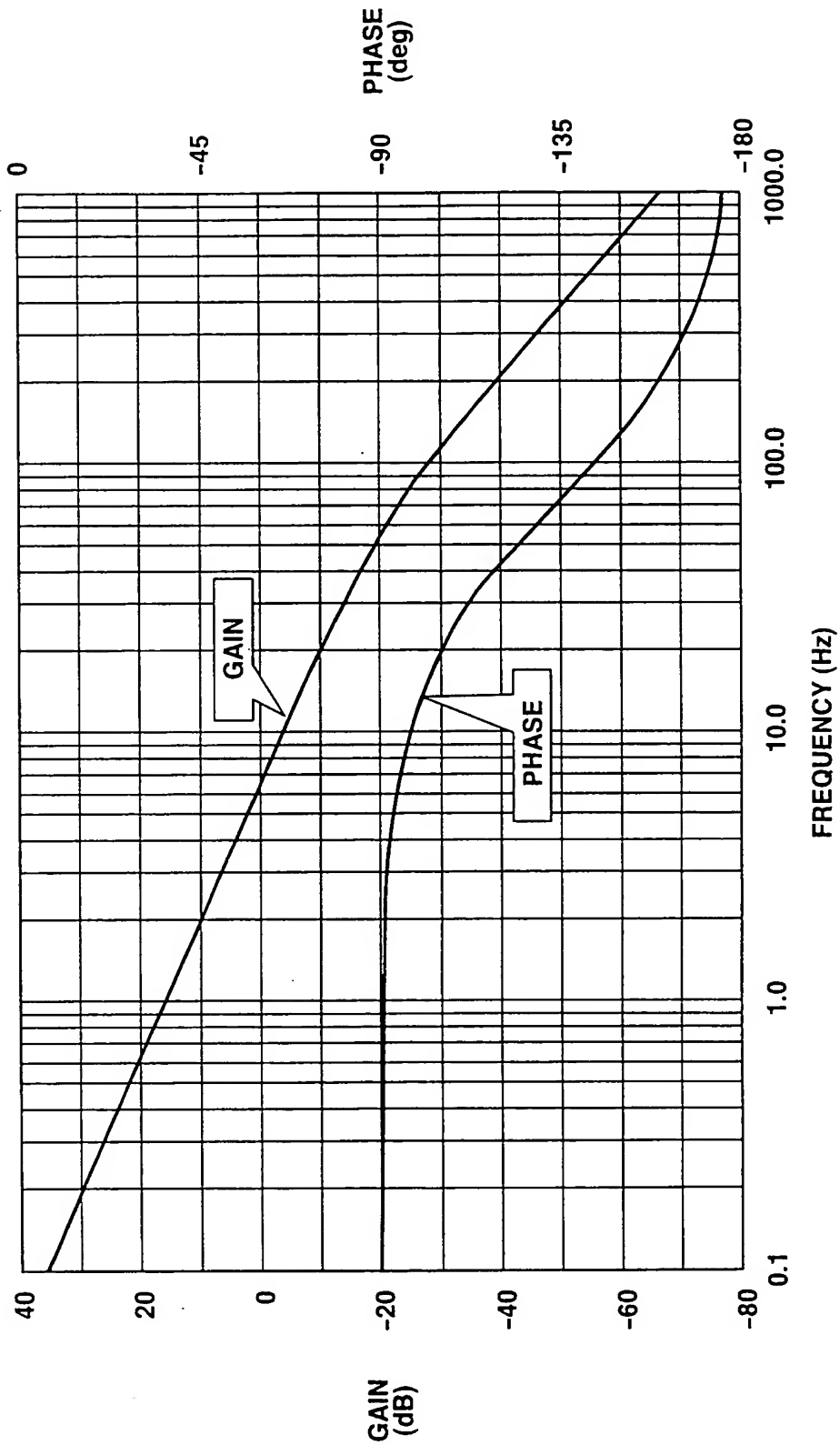


FIG.6

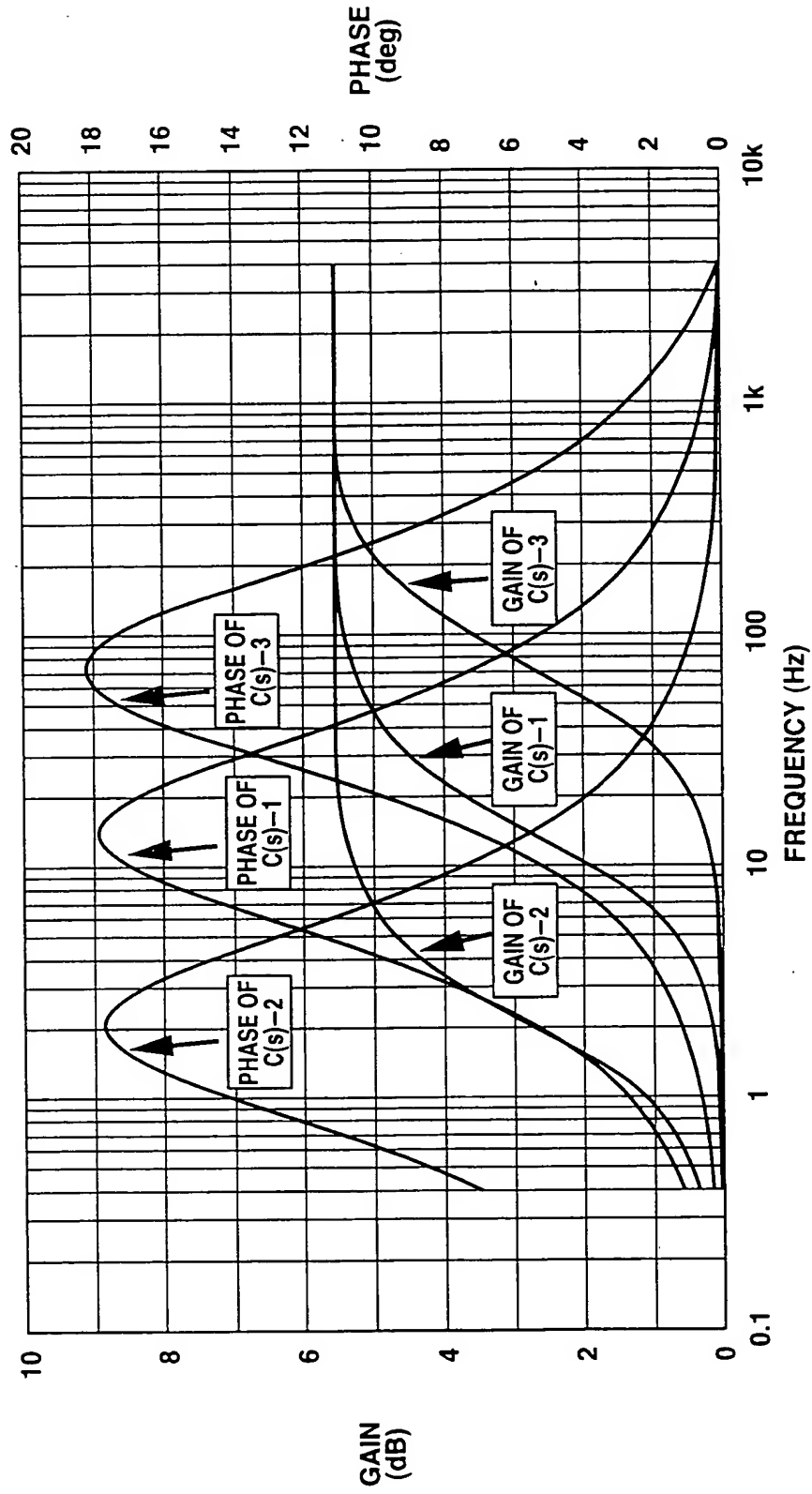


FIG.7

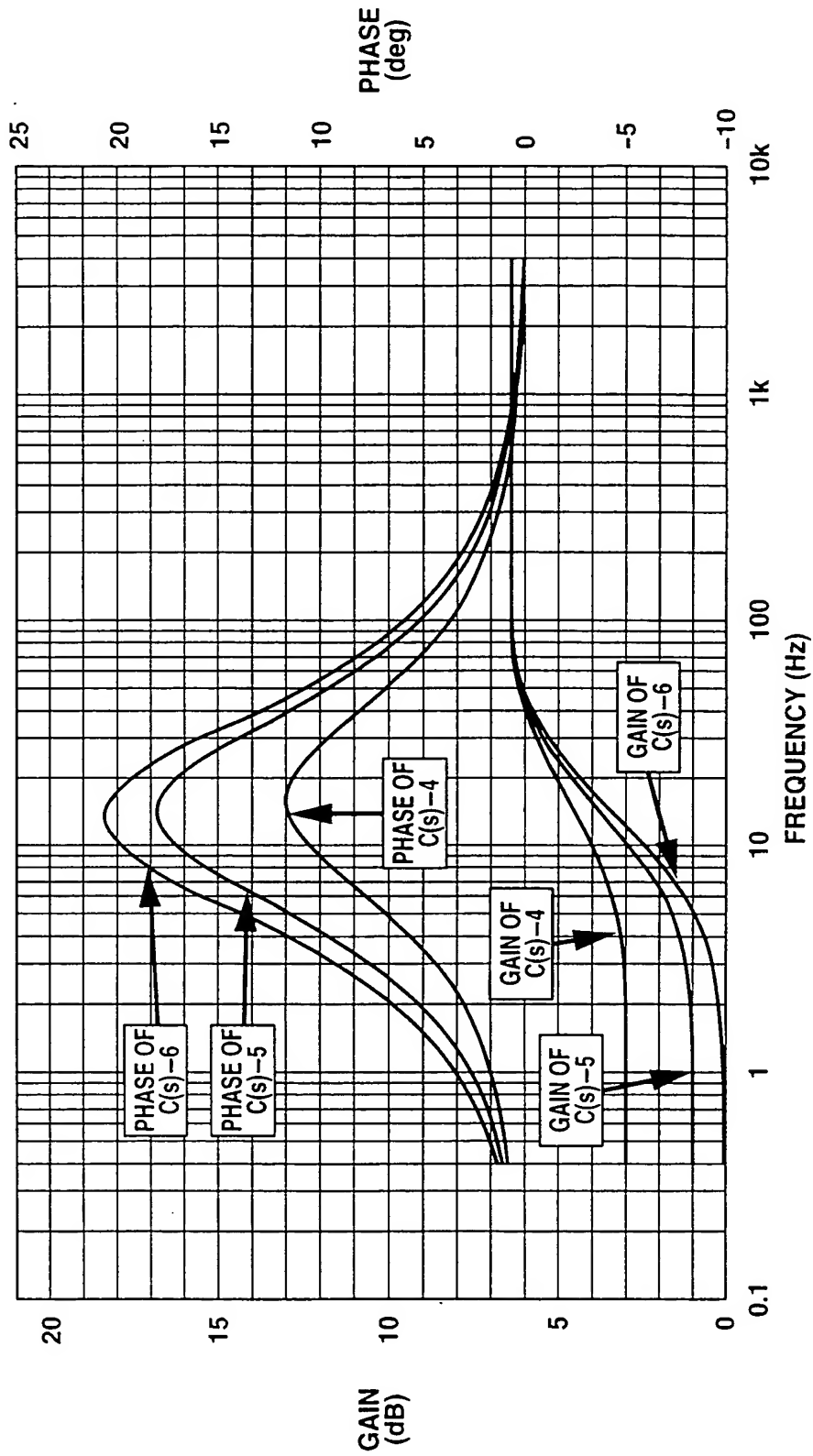


FIG.8

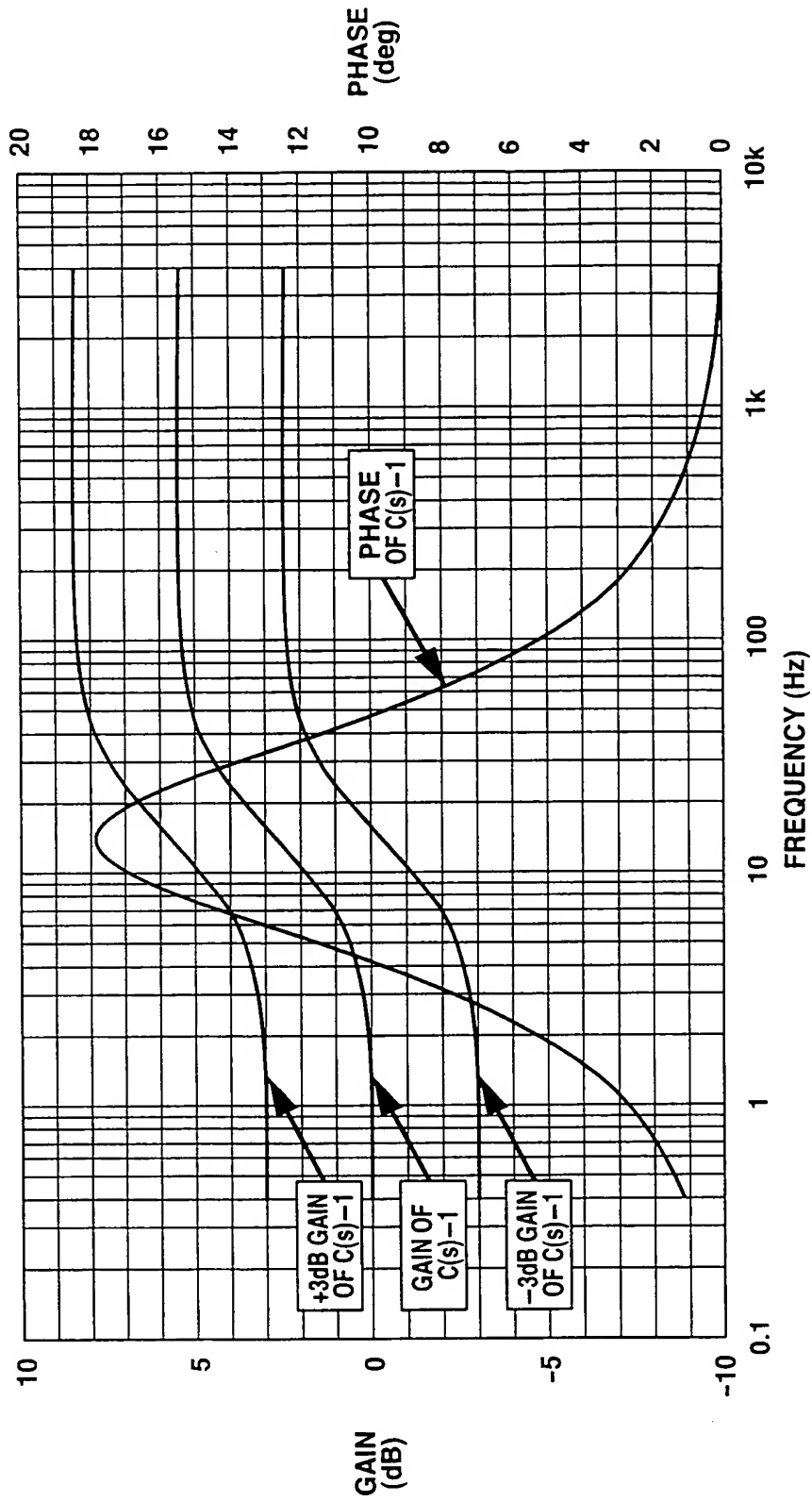


FIG.9

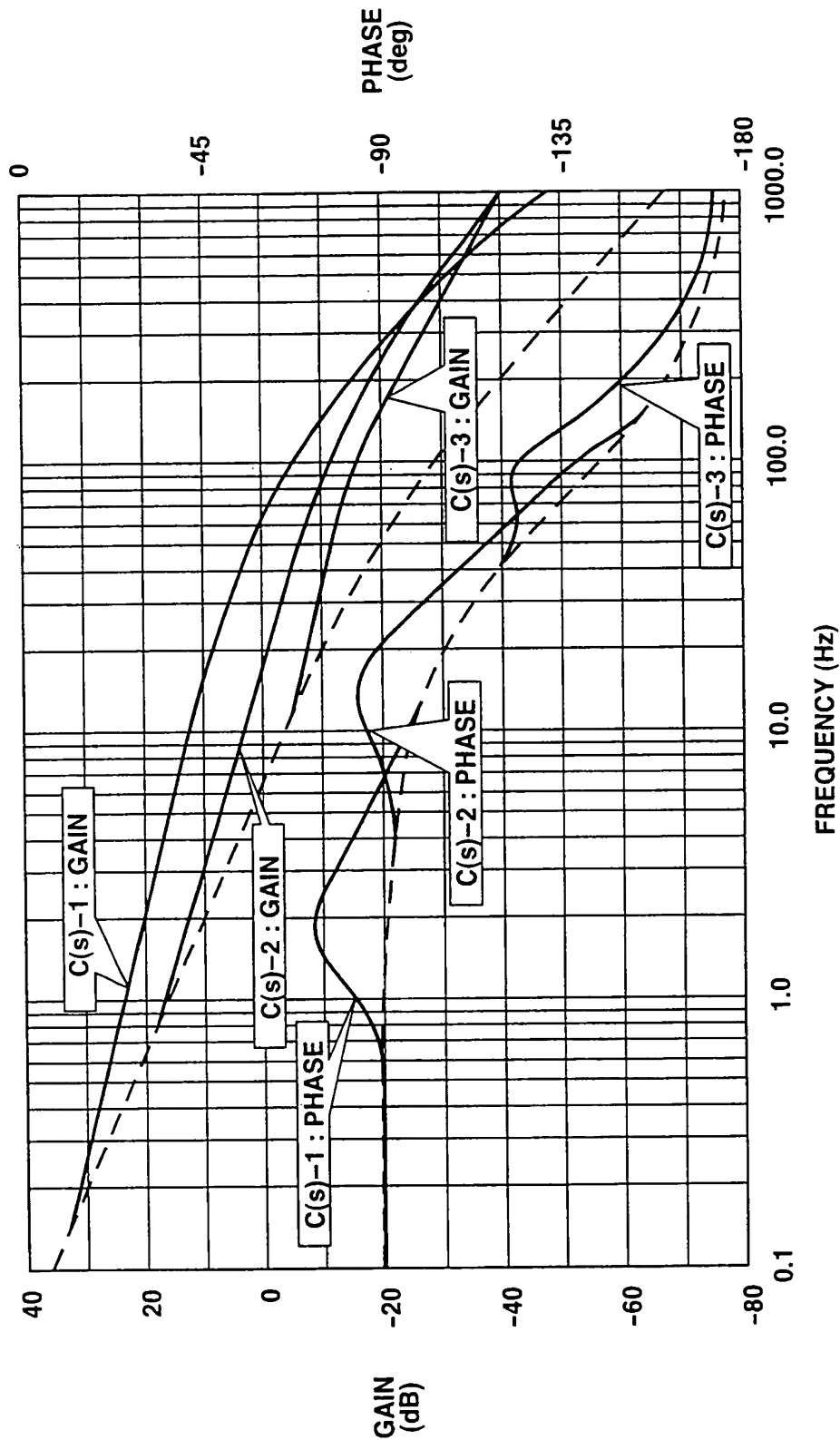


FIG.10

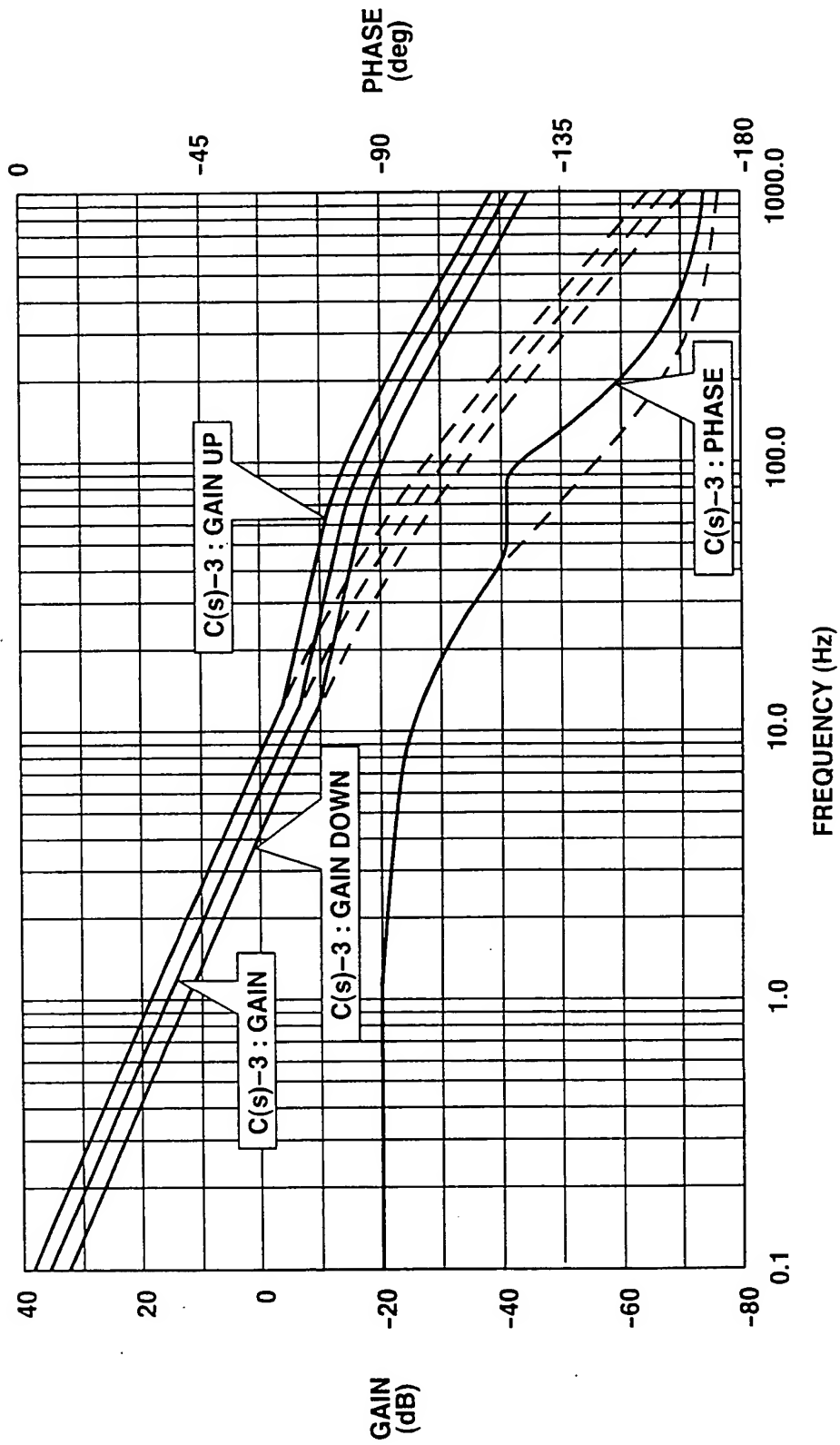


FIG.11

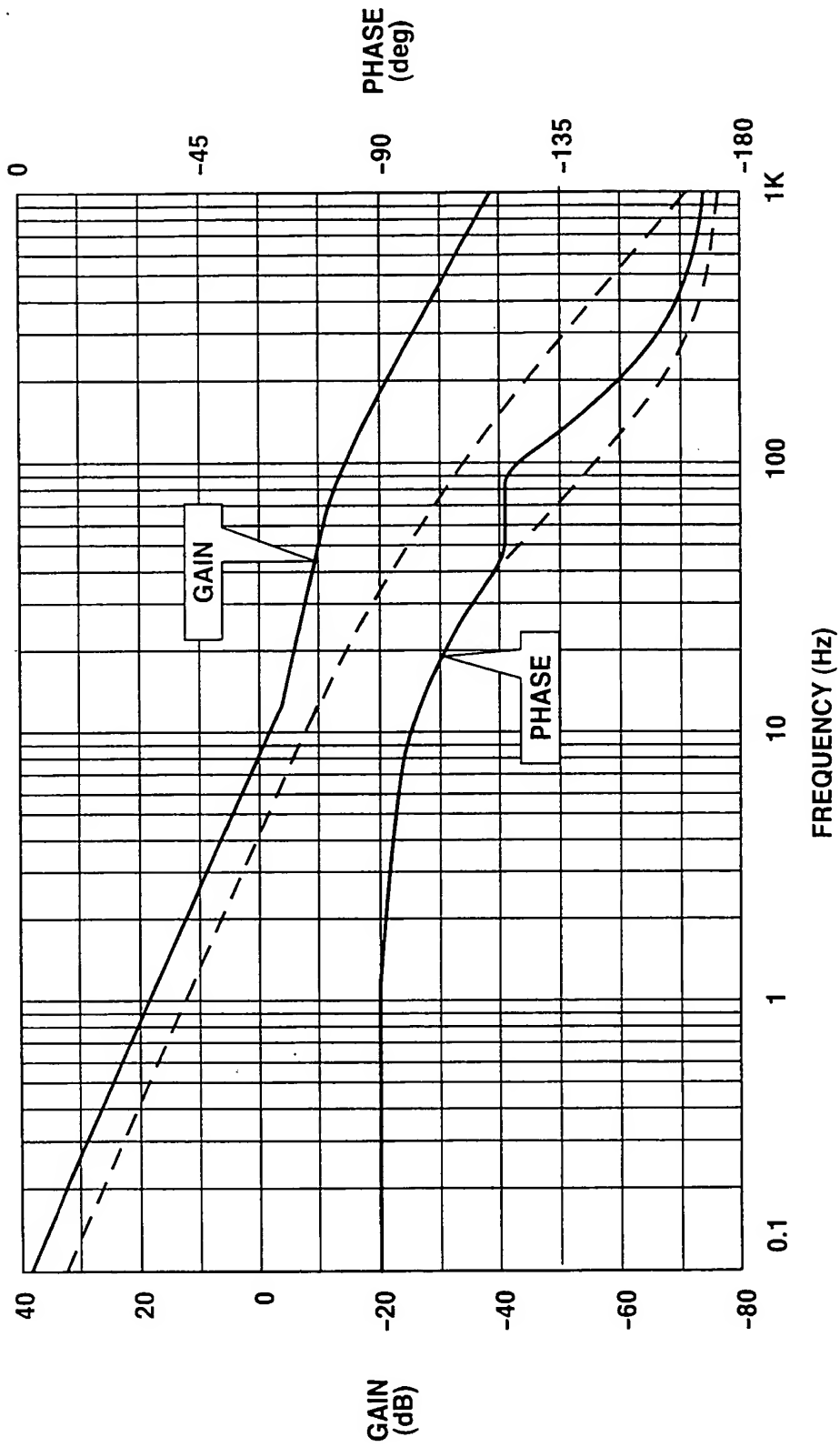


FIG.12

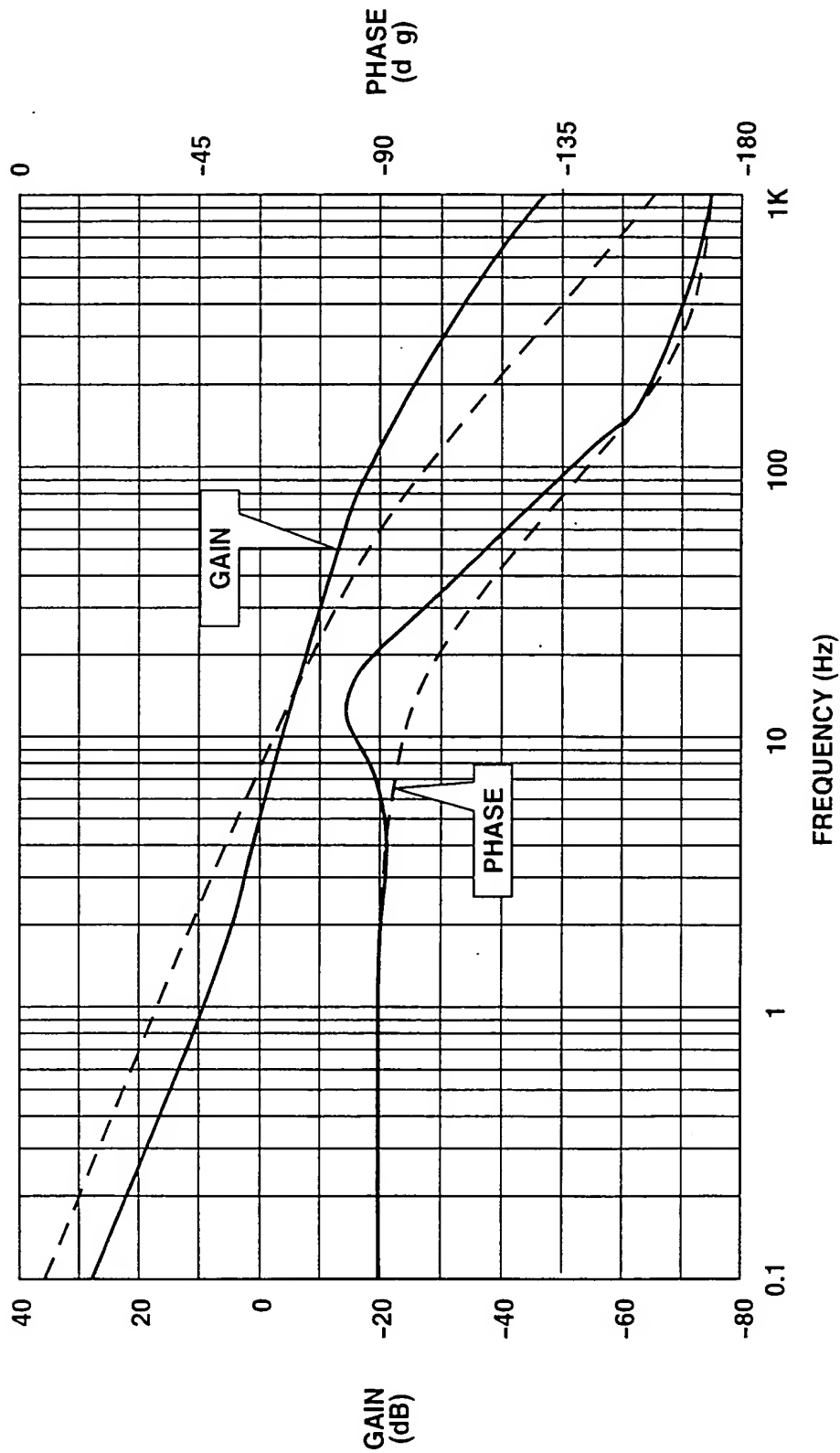


FIG.13

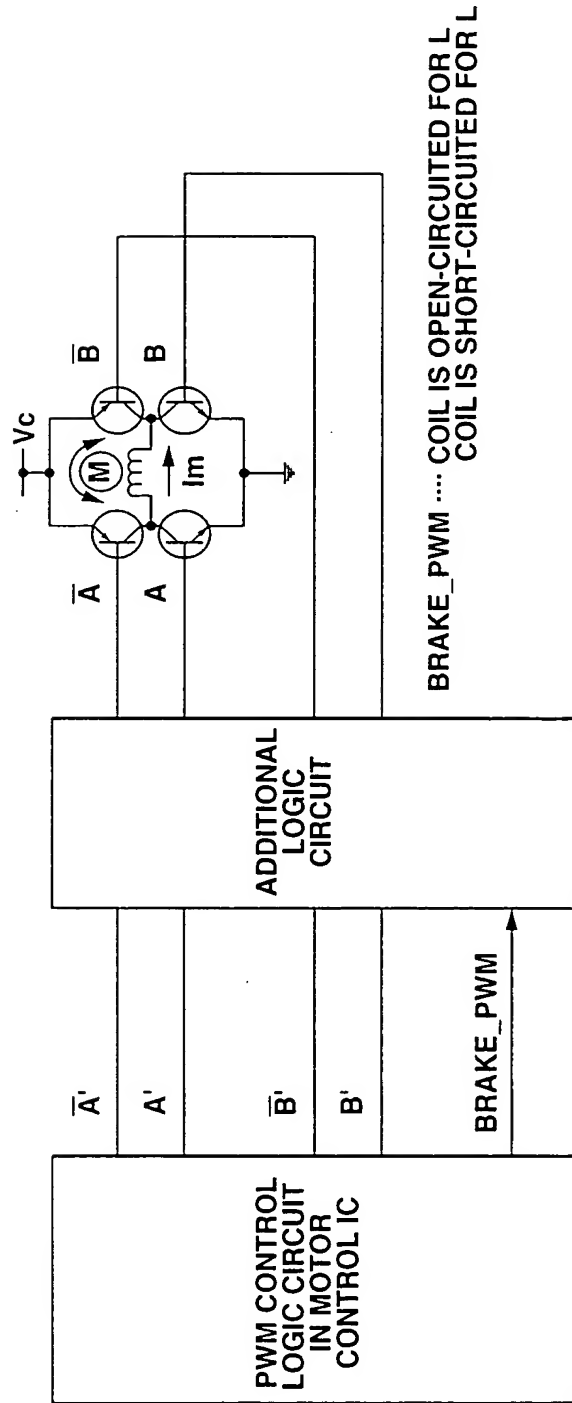


FIG.14

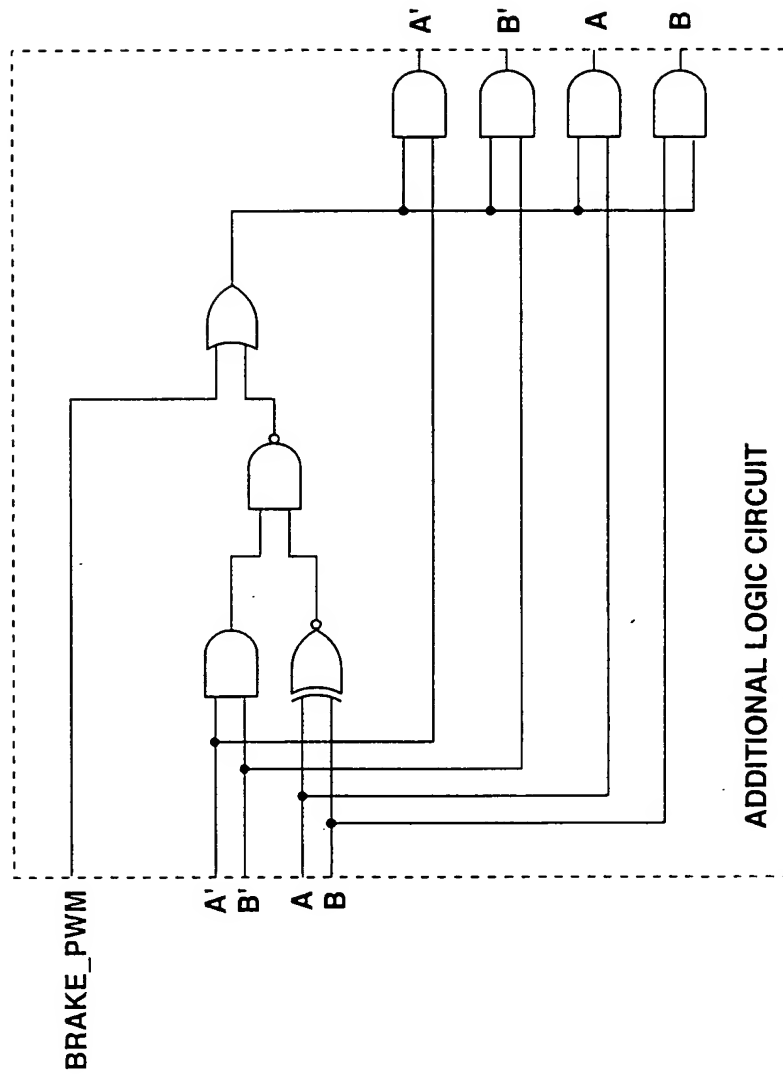


FIG.15

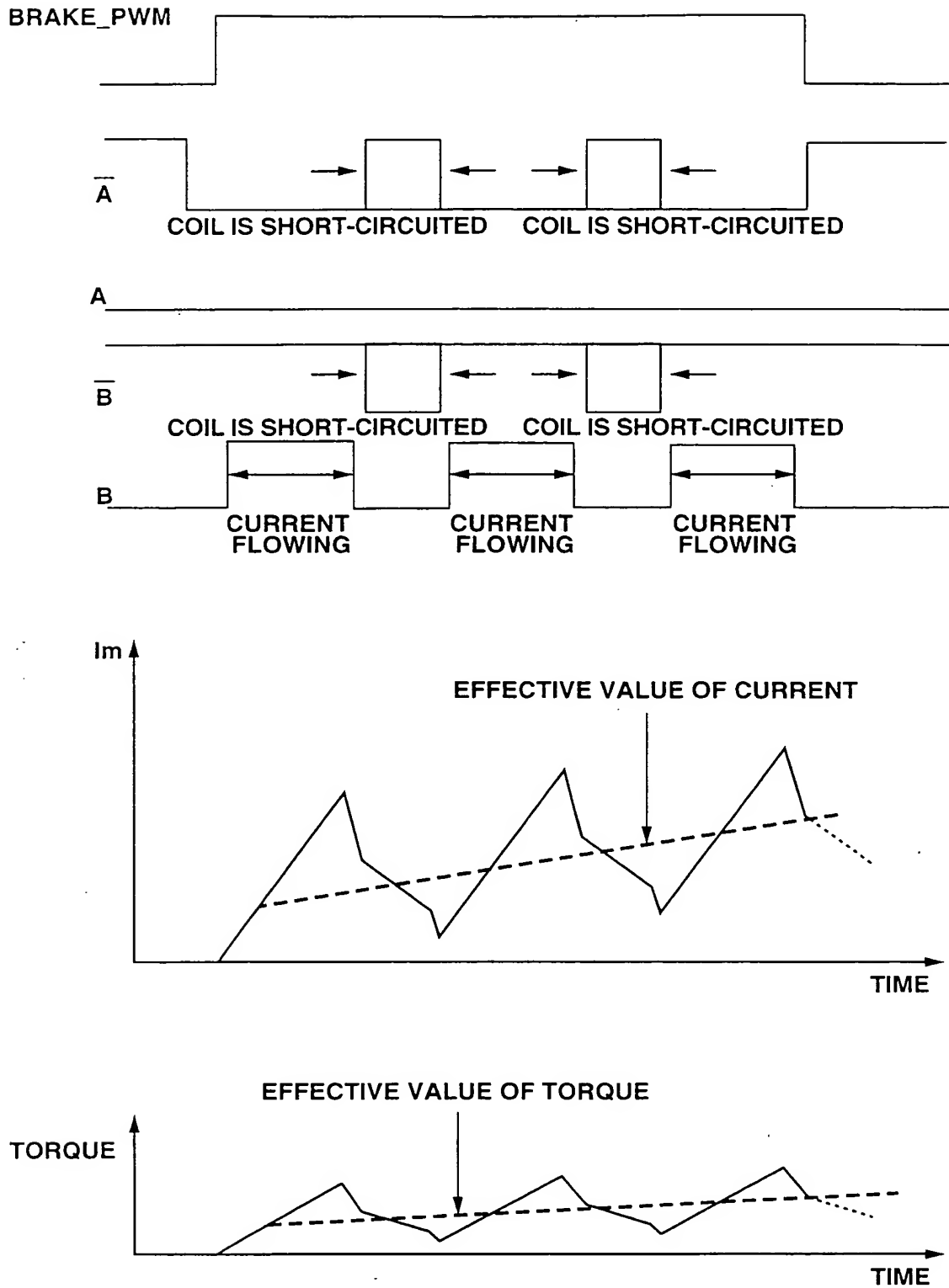


FIG.16

BRAKE_PWM

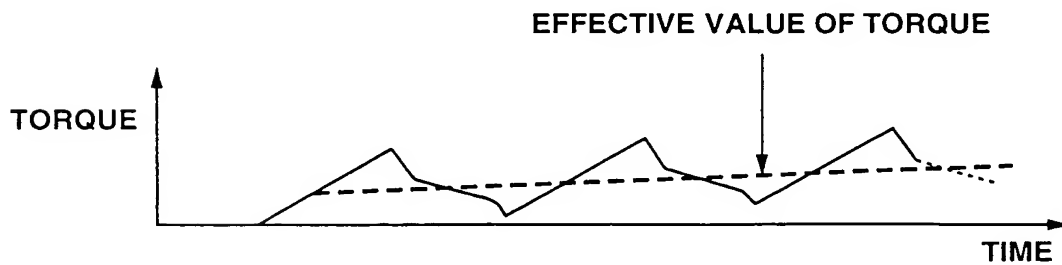
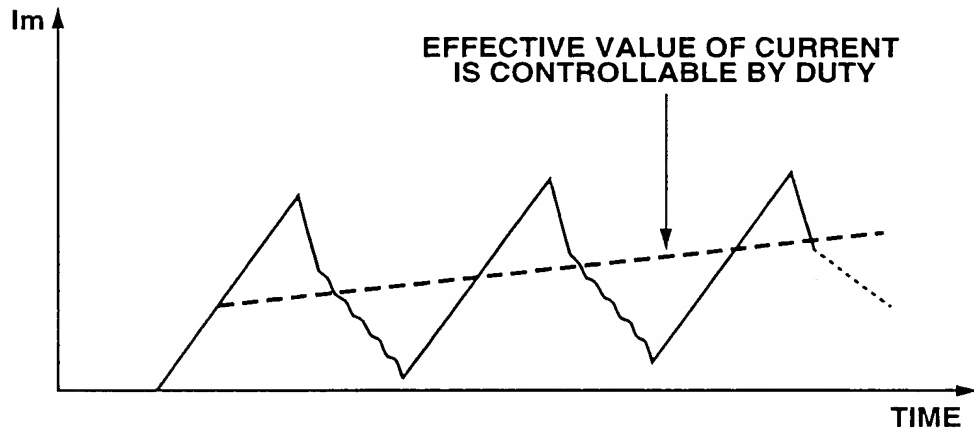
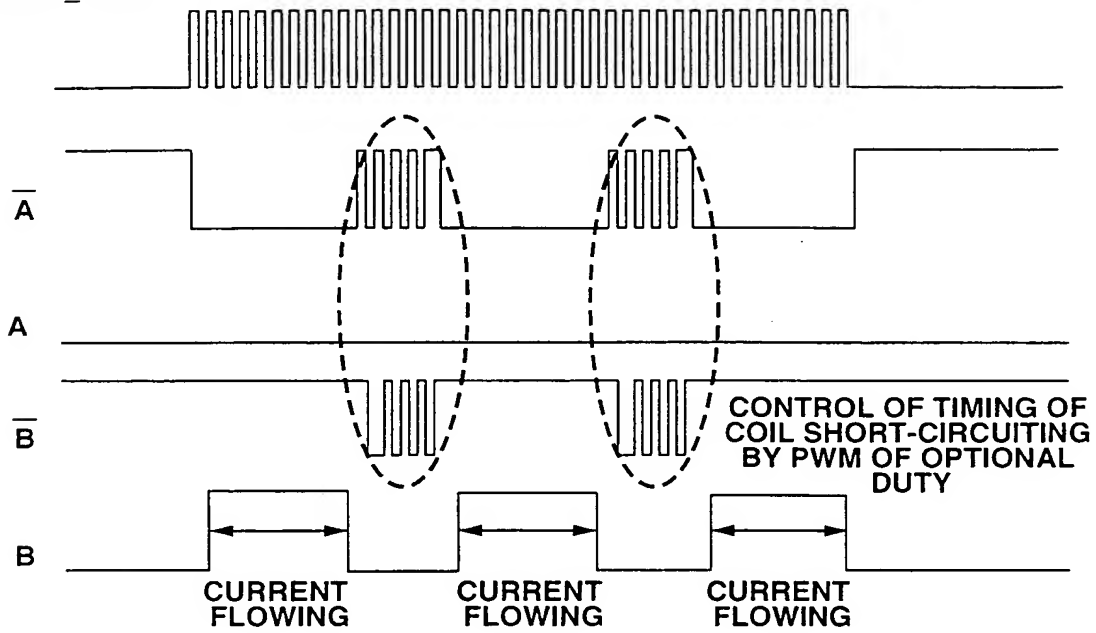


FIG.17

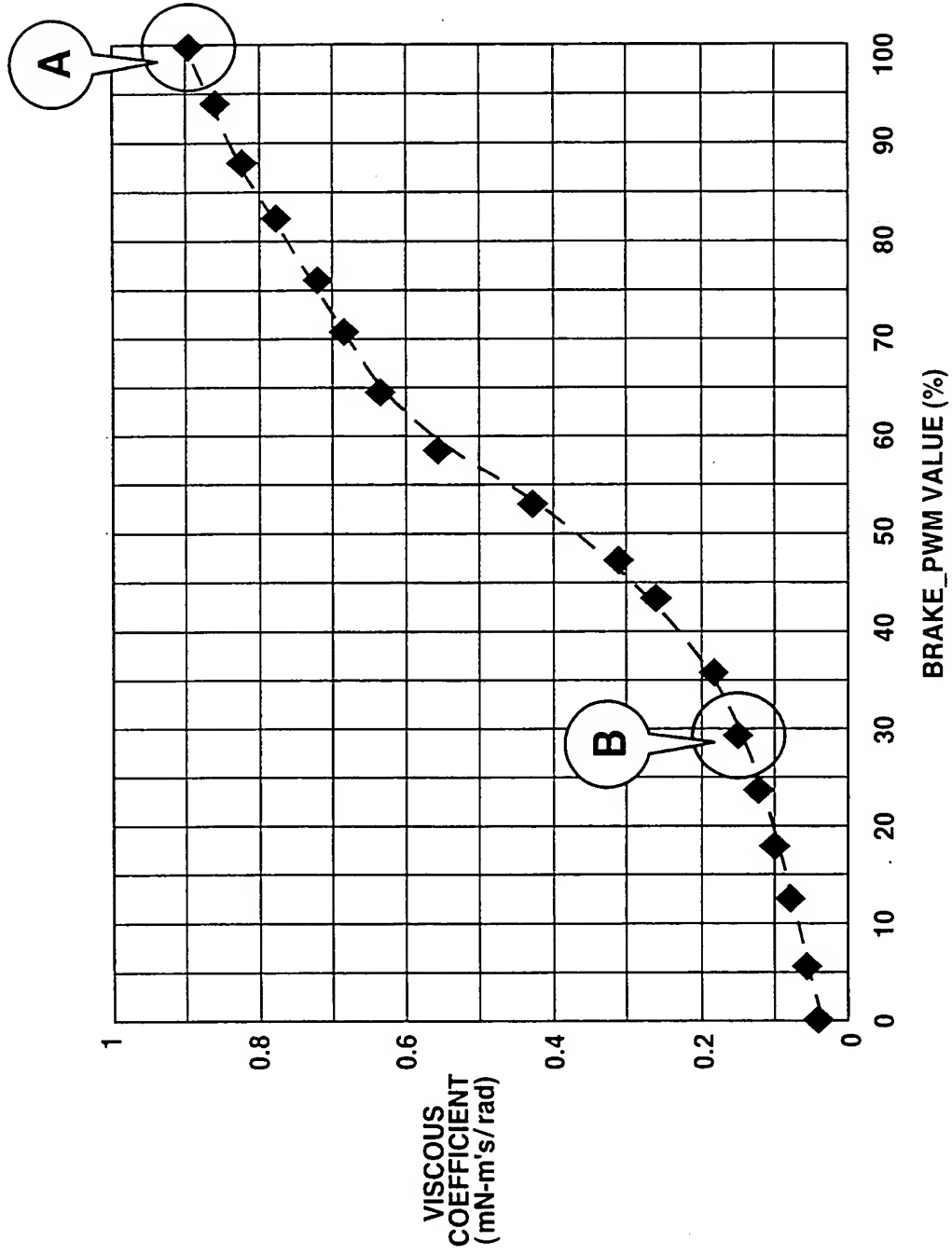


FIG.18

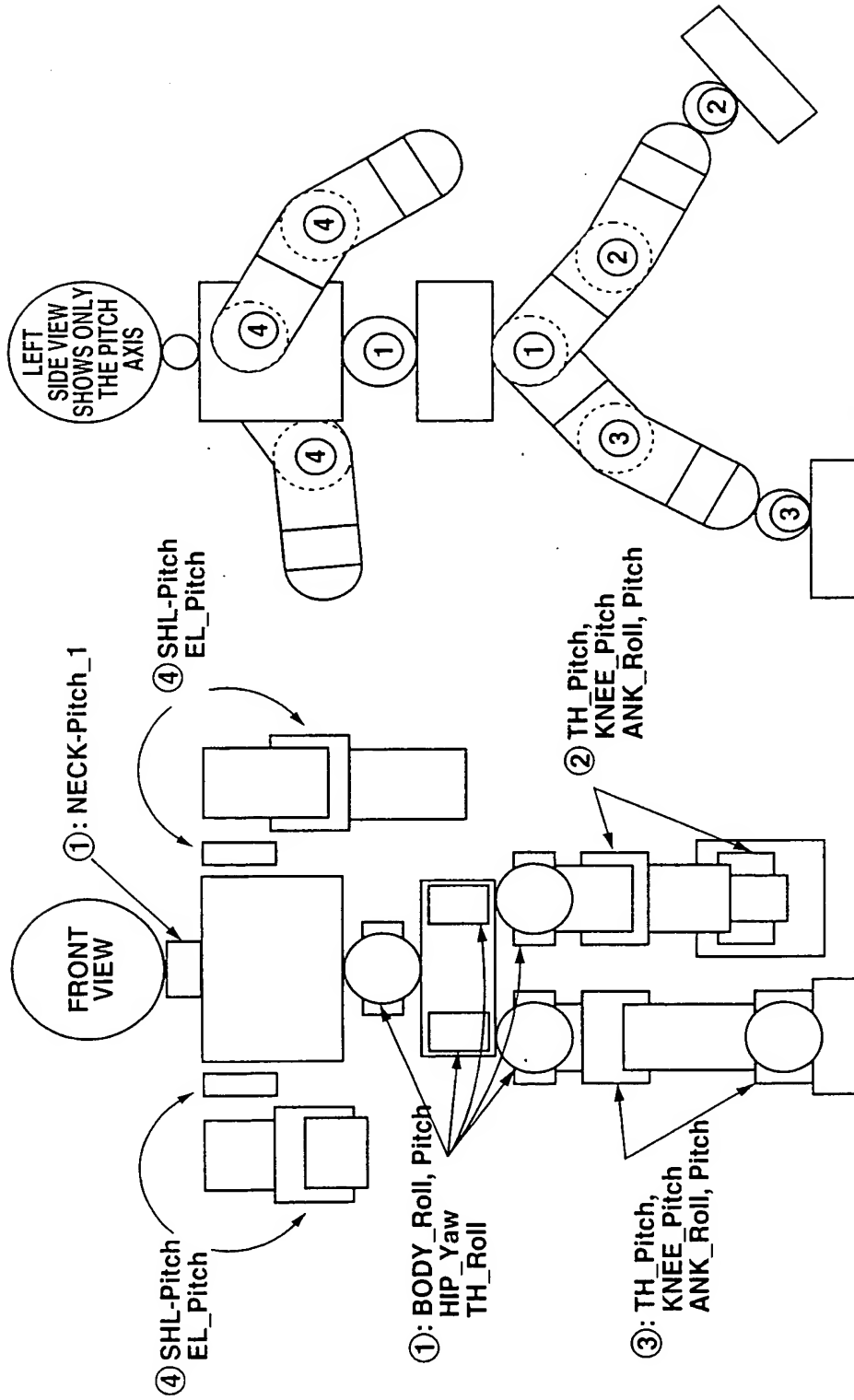
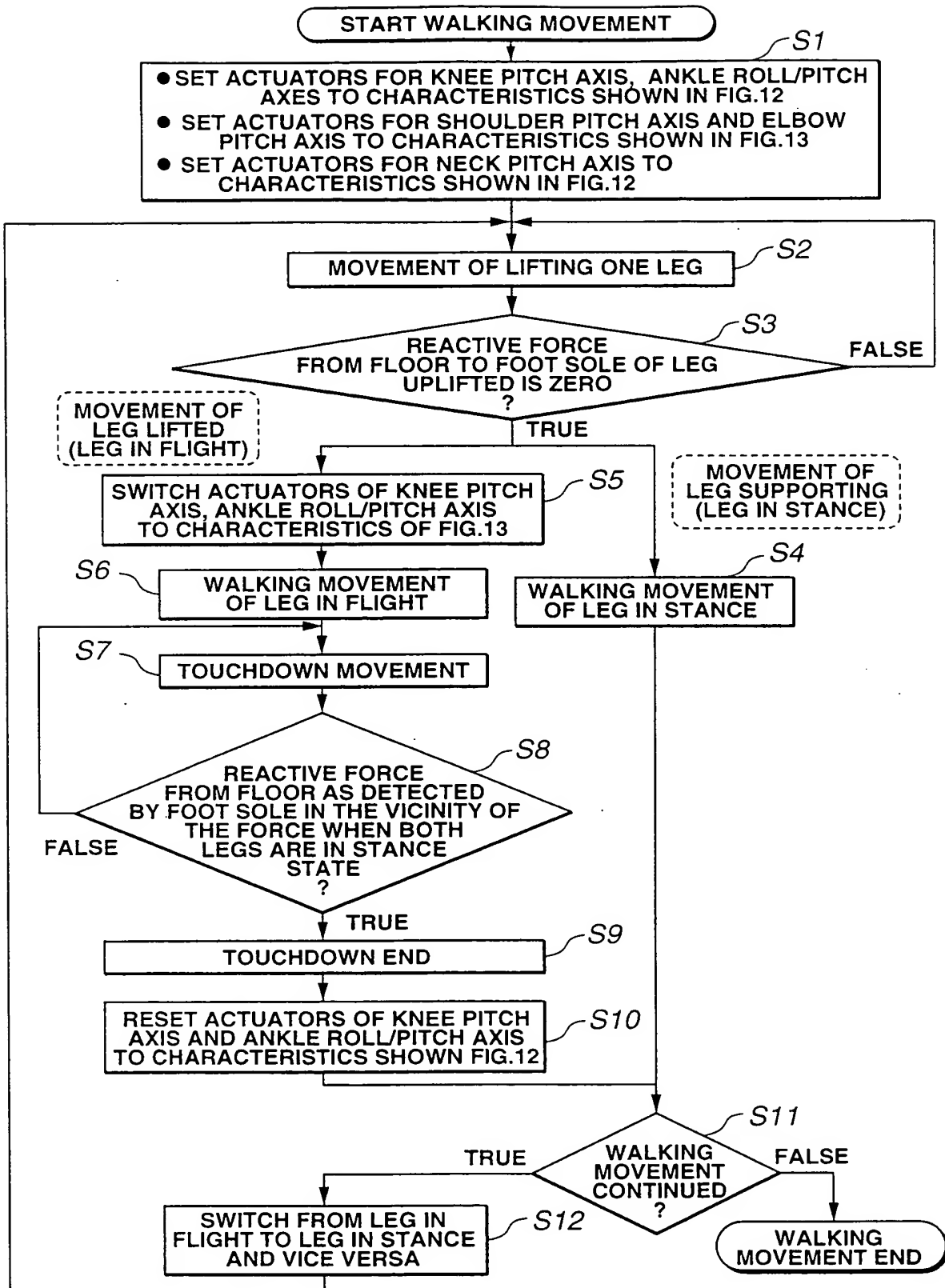


FIG.19



LOWER LIMBS (BOTH LEGS) AND FLOOR SURFACE DEFINE
CLOSED LINK DURING UPSTANDING OF THE ROBOT

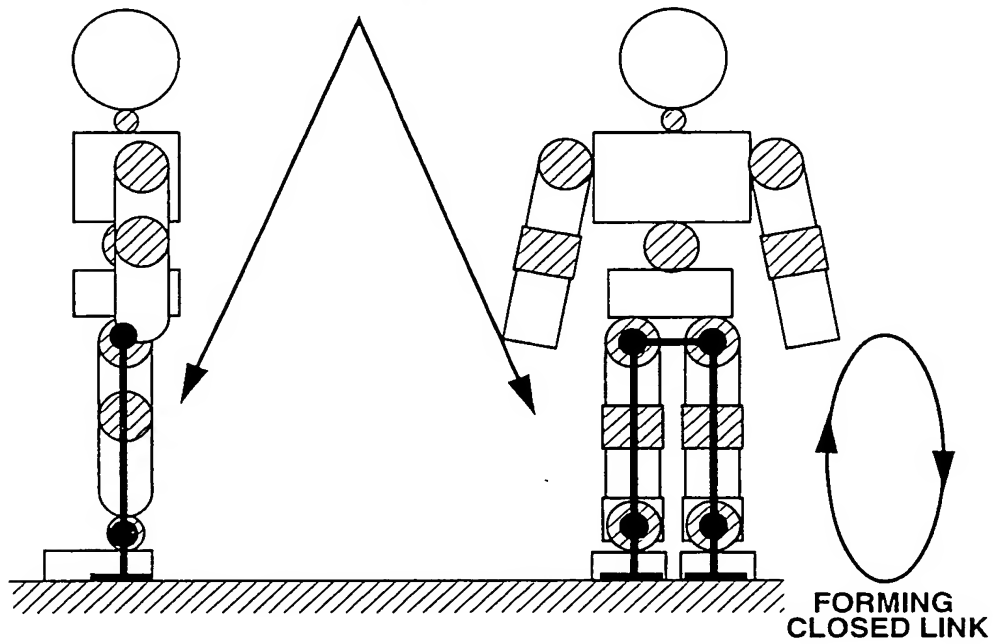


FIG.21

LOWER LIMBS (BOTH LEGS) AND FLOOR SURFACE DEFINE
OPEN LINK DURING UPSTANDING OF THE ROBOT

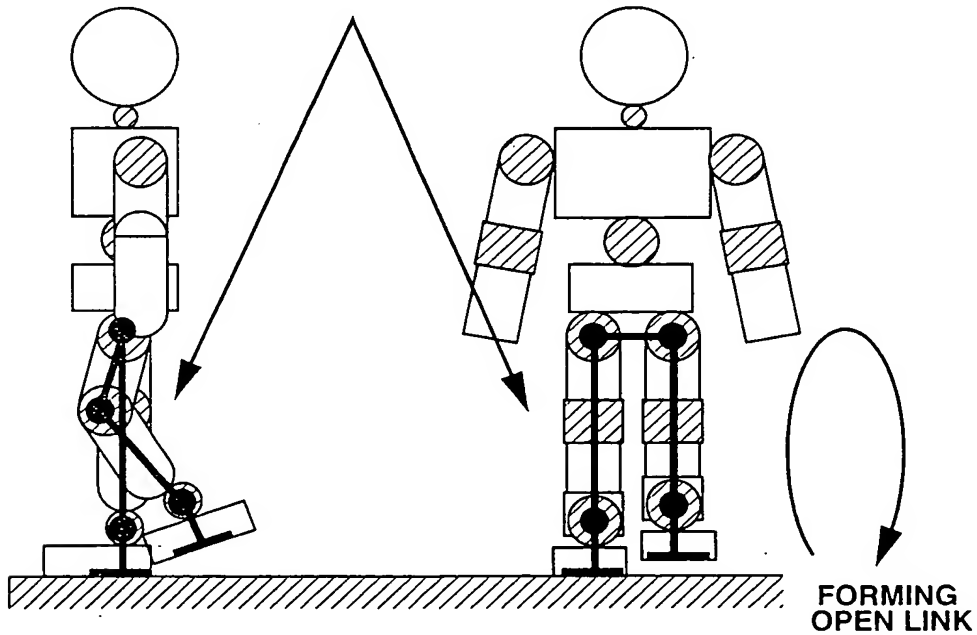


FIG.22

**STIFF JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.12)

JOINT VISCOSITY
(FIG.18A)

**INTERMEDIATE JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18A)

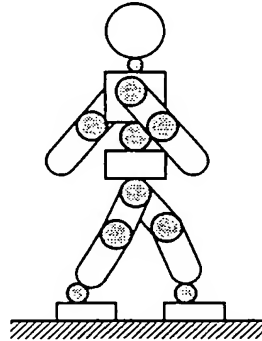
**SOFT JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18B)

TIME PERIOD WHEN BOTH
LEGS ARE IN STANCE

LOWER LIMBS FORM
A CLOSED LINK SYSTEM
WITH FLOOR SURFACE



RIGHT	SHOULDER PITCH	STIFF JOINT CHARACTERISTICS	
	ELBOW PITCH	STIFF JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	SHOULDER PITCH	STIFF JOINT CHARACTERISTICS	
	ELBOW PITCH	STIFF JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.23

**STIFF JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.12)
JOINT VISCOSITY
(FIG.18A)

**INTERMEDIATE JOINT
CHARACTERISTICS**

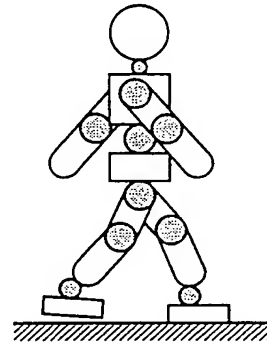
SERVO CHARACTERISTICS
(FIG.13)
JOINT VISCOSITY
(FIG.18A)

**SOFT JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)
JOINT VISCOSITY
(FIG.18B)

INSTANT OF
CLEARING THE FLOOR

ROBOT BODY (LEGS, BODY
TRUNK AND ARMS) FORMS
A CLOSED LINK SYSTEM
WITH FLOOR SURFACE



RIGHT	SHOULDER PITCH	STIFF JOINT CHARACTERISTICS	
	ELBOW PITCH	STIFF JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	SHOULDER PITCH	STIFF JOINT CHARACTERISTICS	
	ELBOW PITCH	STIFF JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.24

**STIFF JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.12)
JOINT VISCOSITY
(FIG.18A)

**INTERMEDIATE JOINT
CHARACTERISTICS**

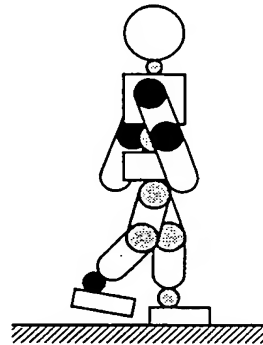
SERVO CHARACTERISTICS
(FIG.13)
JOINT VISCOSITY
(FIG.18A)

**SOFT JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)
JOINT VISCOSITY
(FIG.18B)

TIME PERIOD WHEN A SOLE
LEG IS IN STANCE
(ANOTHER LEG BEING LIFTED)

ROBOT BODY (LEGS, BODY
TRUNK AND ARMS) FORMS
A CLOSED LINK SYSTEM
WITH FLOOR SURFACE



RIGHT	SHOULDER PITCH	SOFT JOINT CHARACTERISTICS	
	ELBOW PITCH	SOFT JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
LEFT	SHOULDER PITCH	STIFF JOINT CHARACTERISTICS	
	ELBOW PITCH	STIFF JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.25

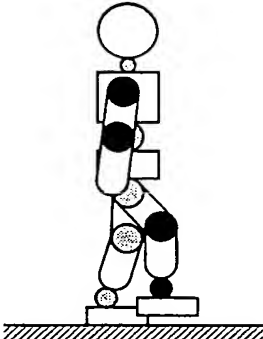
STIFF JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.12) JOINT VISCOSITY (FIG.18A)		TIME PERIOD WHEN A SOLE LEG IS IN STANCE (ANOTHER LEG BEING SWUNG DOWN)	
INTERMEDIATE JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18A)		ROBOT BODY (LEGS, BODY TRUNK AND ARMS) FORMS A CLOSED LINK SYSTEM WITH FLOOR SURFACE	
SOFT JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18B)			
RIGHT	SHOULDER PITCH	SOFT JOINT CHARACTERISTICS	
	ELBOW PITCH	SOFT JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
LEFT	SHOULDER PITCH	STIFF JOINT CHARACTERISTICS	
	ELBOW PITCH	STIFF JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.26

**STIFF JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.12)

JOINT VISCOSITY
(FIG.18A)

**INTERMEDIATE JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18A)

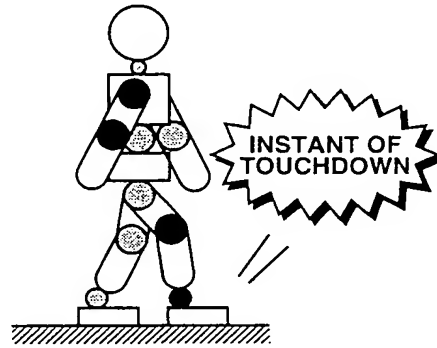
**SOFT JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18B)

INSTANT OF
TOUCHDOWN

LOWER LIMBS FORM
A CLOSED LINK SYSTEM
WITH FLOOR SURFACE



RIGHT	SHOULDER PITCH	SOFT JOINT CHARACTERISTICS	
	ELBOW PITCH	SOFT JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
LEFT	SHOULDER PITCH	STIFF JOINT CHARACTERISTICS	
	ELBOW PITCH	STIFF JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.27

**STIFF JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.12)

JOINT VISCOSITY
(FIG.18A)

**INTERMEDIATE JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18A)

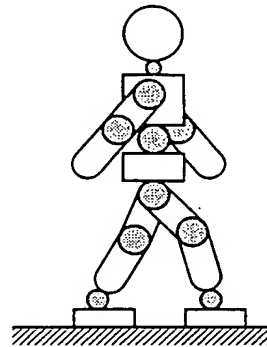
**SOFT JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18B)

TIME PERIOD WHEN BOTH
LEGS ARE IN STANCE

LOWER LIMBS FORM
A CLOSED LINK SYSTEM
WITH FLOOR SURFACE



RIGHT	SHOULDER PITCH	STIFF JOINT CHARACTERISTICS	
	ELBOW PITCH	STIFF JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	SHOULDER PITCH	STIFF JOINT CHARACTERISTICS	
	ELBOW PITCH	STIFF JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.28

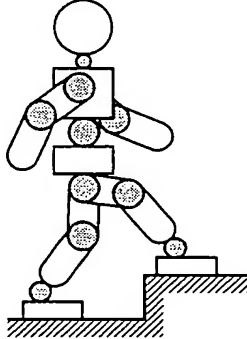
STIFF JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.12) JOINT VISCOSITY (FIG.18A)		TIME PERIOD WHEN BOTH LEGS ARE IN STANCE	
INTERMEDIATE JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18A)		LOWER LIMBS FORM A CLOSED LINK SYSTEM WITH FLOOR SURFACE	
SOFT JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.29

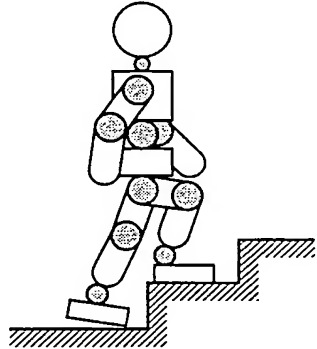
STIFF JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.12) JOINT VISCOSITY (FIG.18A)		INSTANT OF CLEARING THE FLOOR	
INTERMEDIATE JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18A)		TRANSITION FROM CLOSED LINK SYSTEM TO OPEN LINK SYSTEM	
SOFT JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.30

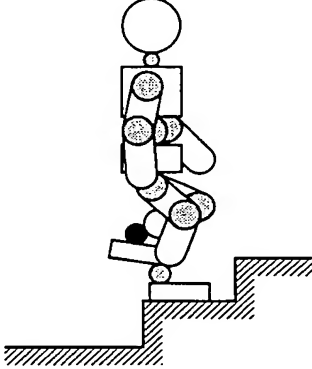
STIFF JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.12) JOINT VISCOSITY (FIG.18A)		TIME PERIOD WHEN A SOLE LEG IS IN STANCE (ANOTHER LEG BEING LIFTED)	
INTERMEDIATE JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18A)		ROBOT BODY (LEGS, BODY TRUNK AND ARMS) FORMS AN OPEN LINK SYSTEM WITH FLOOR SURFACE	
SOFT JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.31

STIFF JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.12)

JOINT VISCOSITY
(FIG.18A)

INTERMEDIATE JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18A)

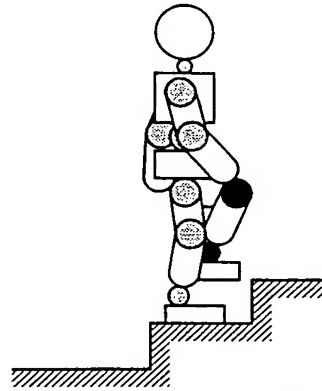
SOFT JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18B)

TIME PERIOD WHEN A SOLE
LEG IS IN STANCE (ANOTHER
LEG BEING SWUNG DOWN)

ROBOT BODY (LEGS, BODY
TRUNK AND ARMS) FORMS
AN OPEN LINK SYSTEM
WITH FLOOR SURFACE



RIGHT	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.32

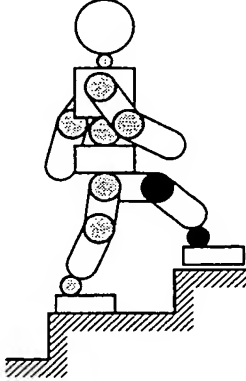
STIFF JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.12) JOINT VISCOSITY (FIG.18A)		INSTANT OF TOUCHDOWN	
INTERMEDIATE JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18A)		LOWER LIMBS FORM A CLOSED LINK SYSTEM WITH FLOOR SURFACE	
SOFT JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.33

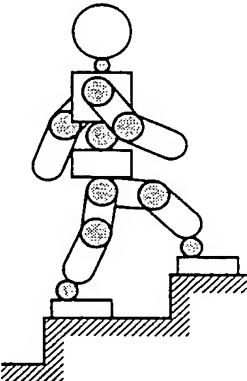
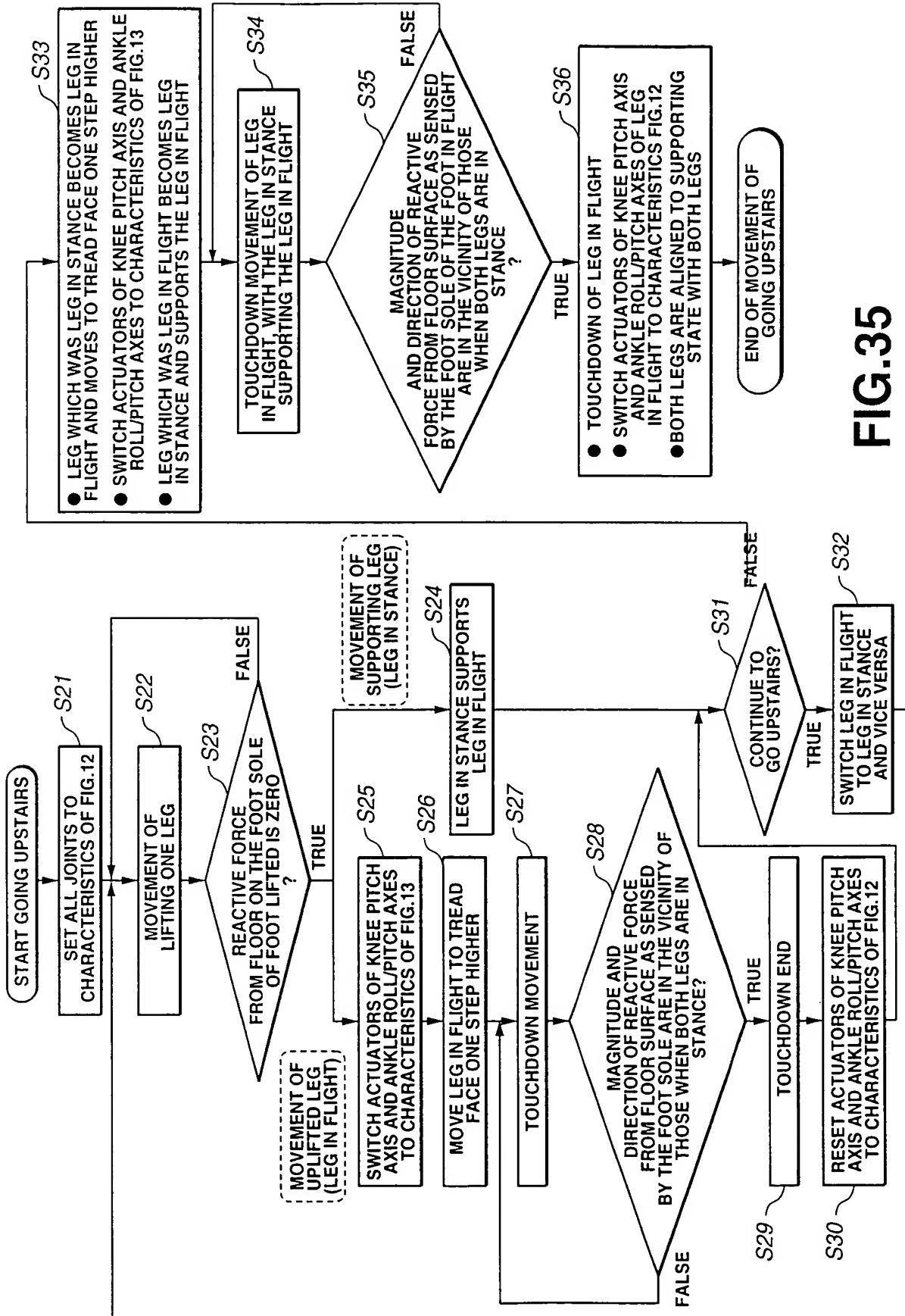
STIFF JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.12) JOINT VISCOSITY (FIG.18A)		TIME PERIOD WHEN BOTH LEGS ARE IN STANCE	
INTERMEDIATE JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18A)		LOWER LIMBS FORM A CLOSED LINK SYSTEM WITH FLOOR SURFACE	
SOFT JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.34



**STIFF JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.12)

JOINT VISCOSITY
(FIG.18A)

**INTERMEDIATE JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18A)

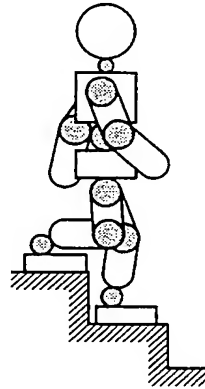
**SOFT JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18B)

TIME PERIOD WHEN BOTH
LEGS ARE IN STANCE

LOWER LIMBS FORM
A CLOSED LINK SYSTEM
WITH FLOOR SURFACE



RIGHT	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.36

**STIFF JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.12)

JOINT VISCOSITY
(FIG.18A)

**INTERMEDIATE JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18A)

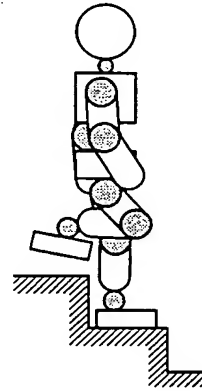
**SOFT JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18B)

INSTANT OF
CLEARING THE FLOOR

ROBOT BODY (LEGS, BODY
TRUNK AND ARMS) FORMS
AN OPEN LINK SYSTEM
WITH FLOOR SURFACE



RIGHT	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.37

**STIFF JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.12)

JOINT VISCOSITY
(FIG.18A)

**INTERMEDIATE JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18A)

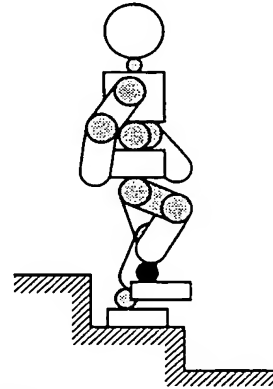
**SOFT JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18B)

TIME PERIOD WHEN A SOLE
LEG IS IN STANCE
(ANOTHER LEG BEING LIFTED)

ROBOT BODY (LEGS, BODY
TRUNK AND ARMS) FORMS
A CLOSED LINK SYSTEM
WITH FLOOR SURFACE



RIGHT	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.38

STIFF JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.12)

JOINT VISCOSITY
(FIG.18A)

INTERMEDIATE JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18A)

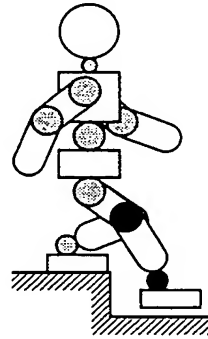
SOFT JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18B)

TIME PERIOD WHEN A SOLE
LEG IS IN STANCE (ANOTHER
LEG BEING SWUNG DOWN)

ROBOT BODY (LEGS, BODY
TRUNK AND ARMS) FORMS
AN OPEN LINK SYSTEM
WITH FLOOR SURFACE



RIGHT	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.39

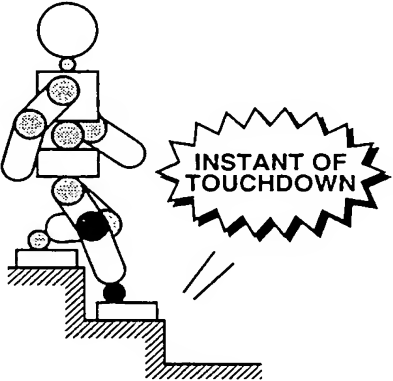
STIFF JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.12) JOINT VISCOSITY (FIG.18A)		INSTANT OF TOUCHDOWN	
INTERMEDIATE JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18A)		LOWER LIMBS FORM A CLOSED LINK SYSTEM WITH FLOOR SURFACE	
SOFT JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.40

**STIFF JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.12)

JOINT VISCOSITY
(FIG.18A)

**INTERMEDIATE JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18A)

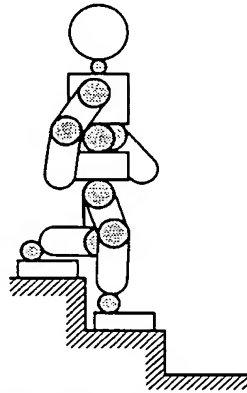
**SOFT JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18B)

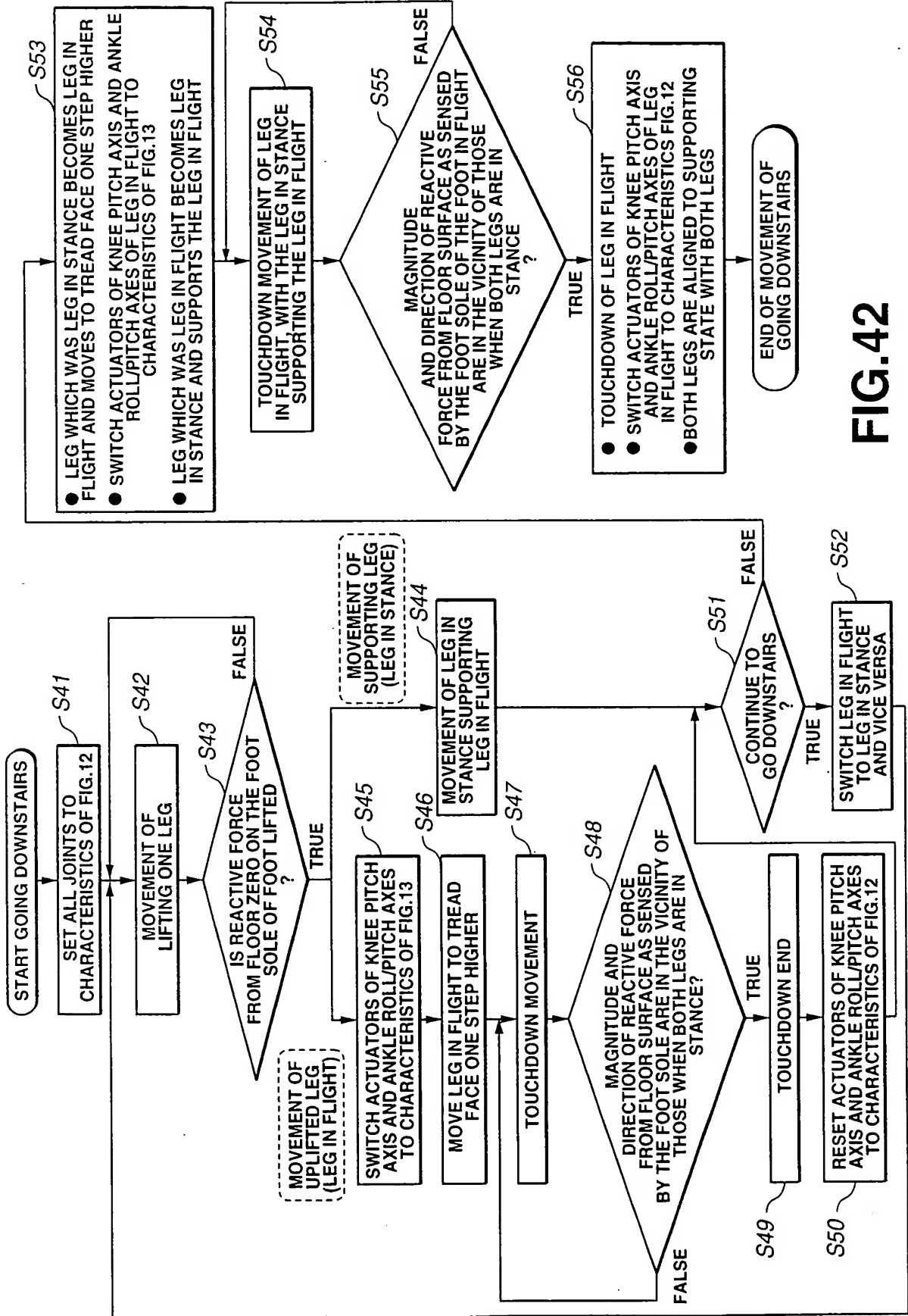
TIME PERIOD WHEN BOTH
LEGS ARE IN STANCE

LOWER LIMBS FORM
A CLOSED LINK SYSTEM
WITH FLOOR SURFACE



RIGHT	THIGH ROLL	LEG IN STANCE	INTERMEDIATEJOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATEJOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATEJOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATEJOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATEJOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN STANCE	INTERMEDIATEJOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATEJOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATEJOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATEJOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATEJOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.41



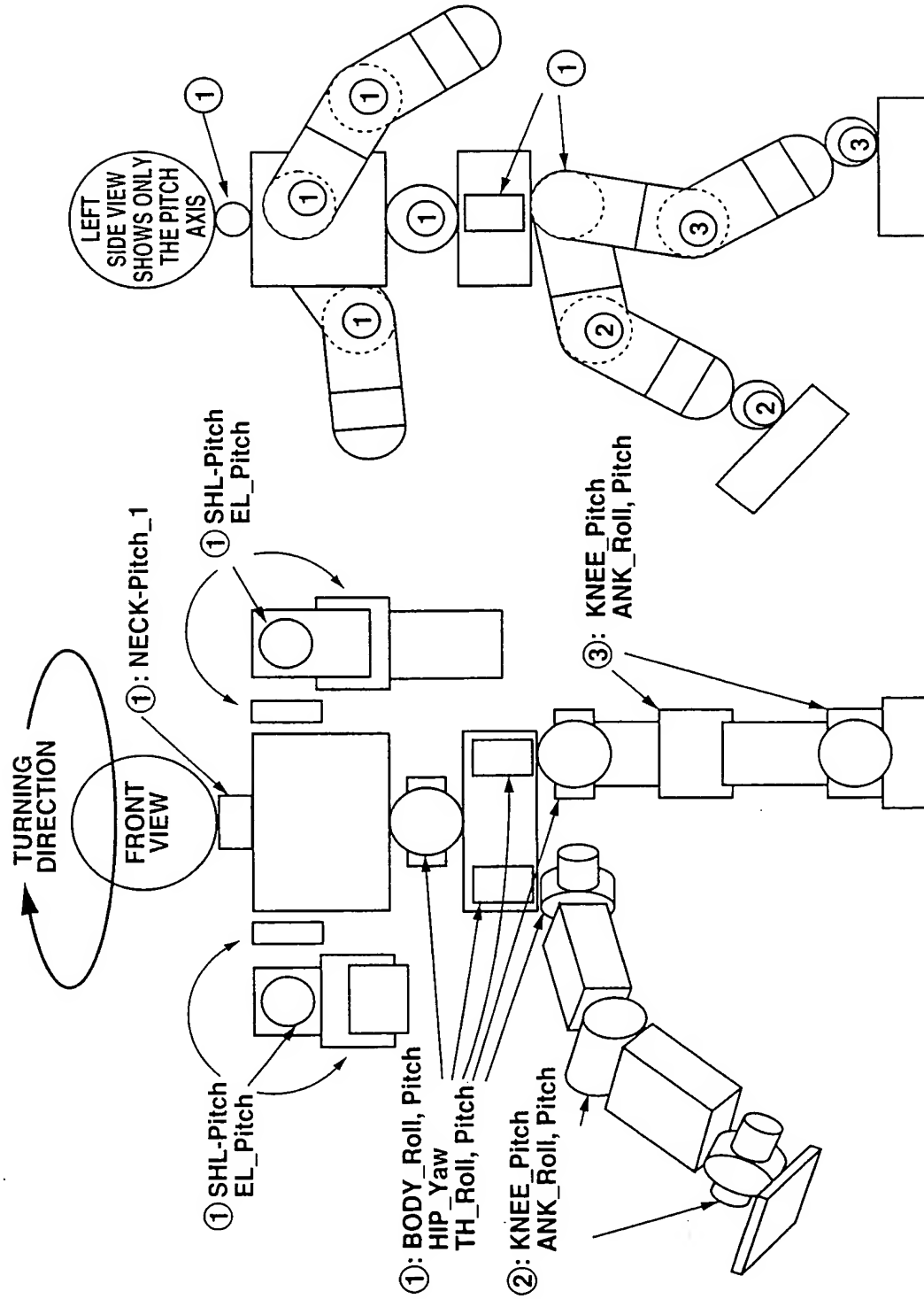


FIG.43

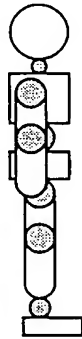
STIFF JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.12) JOINT VISCOSITY (FIG.18A)		TIME PERIOD WHEN BOTH LEGS ARE IN STANCE	
INTERMEDIATE JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18A)		LOWER LIMBS FORM A CLOSED LINK SYSTEM WITH FLOOR SURFACE	
SOFT JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH YAW	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	THIGH YAW	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.44

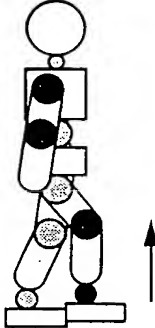
STIFF JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.12) JOINT VISCOSITY (FIG.18A)		TIME PERIOD WHEN A SOLE LEG IS IN STANCE (ANOTHER LEG BEING LIFTED)	
INTERMEDIATE JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18A)		ROBOT BODY (LEGS, BODY TRUNK AND ARMS) FORMS AN OPEN LINK SYSTEM WITH FLOOR SURFACE	
SOFT JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH YAW	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
LEFT	THIGH YAW	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.45

**STIFF JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.12)
JOINT VISCOSITY
(FIG.18A)

**INTERMEDIATE JOINT
CHARACTERISTICS**

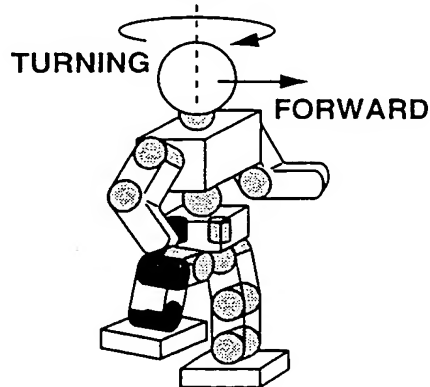
SERVO CHARACTERISTICS
(FIG.13)
JOINT VISCOSITY
(FIG.18A)

**SOFT JOINT
CHARACTERISTICS**

SERVO CHARACTERISTICS
(FIG.13)
JOINT VISCOSITY
(FIG.18B)

TIME PERIOD WHEN A SOLE
LEG IS IN STANCE

ROBOT BODY (LEGS, BODY
TRUNK AND ARMS) FORMS
AN OPEN LINK SYSTEM
WITH FLOOR SURFACE



RIGHT	THIGH YAW	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
LEFT	THIGH YAW	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.46

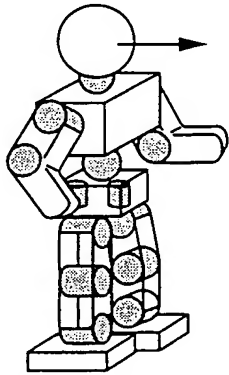
STIFF JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.12) JOINT VISCOSITY (FIG.18A)		TIME PERIOD WHEN BOTH LEGS ARE IN STANCE	
INTERMEDIATE JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18A)		LOWER LIMBS FORM A CLOSED LINK SYSTEM WITH FLOOR SURFACE	
SOFT JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH YAW	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	THIGH YAW	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.47

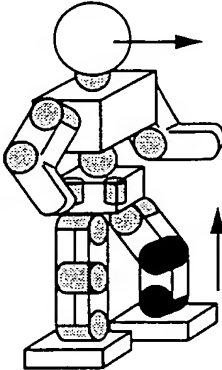
STIFF JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.12) JOINT VISCOSITY (FIG.18A)		TIME PERIOD WHEN A SOLE LEG IS IN STANCE	
INTERMEDIATE JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18A)		ROBOT BODY (LEGS, BODY TRUNK AND ARMS) FORMS AN OPEN LINK SYSTEM WITH FLOOR SURFACE	
SOFT JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH YAW	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
LEFT	THIGH YAW	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.48

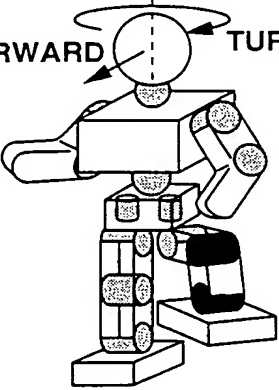
STIFF JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.12) JOINT VISCOSITY (FIG.18A)		TIME PERIOD WHEN A SOLE LEG IS IN STANCE	
INTERMEDIATE JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18A)		ROBOT BODY (LEGS, BODY TRUNK AND ARMS) FORMS AN OPEN LINK SYSTEM WITH FLOOR SURFACE	
SOFT JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18B)		 <p>Diagram illustrating the robot body (legs, body trunk and arms) forming an open link system with the floor surface. The diagram shows a robot body with a head, torso, and legs. Arrows indicate 'FORWARD' and 'TURNING' movements.</p>	
RIGHT	THIGH YAW	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
LEFT	THIGH YAW	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.49

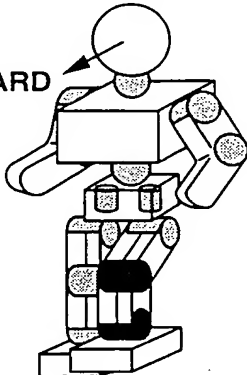
STIFF JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.12) JOINT VISCOSITY (FIG.18A)		TIME PERIOD WHEN A SOLE LEG IS IN STANCE	
INTERMEDIATE JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18A)		ROBOT BODY (LEGS, BODY TRUNK AND ARMS) FORMS AN OPEN LINK SYSTEM WITH FLOOR SURFACE	
SOFT JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH YAW	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
LEFT	THIGH YAW	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.50

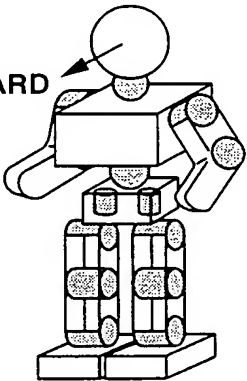
STIFF JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.12) JOINT VISCOSITY (FIG.18A)		TIME PERIOD WHEN BOTH LEGS ARE IN STANCE	
INTERMEDIATE JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18A)		LOWER LIMBS FORM A CLOSED LINK SYSTEM WITH FLOOR SURFACE	
SOFT JOINT CHARACTERISTICS SERVO CHARACTERISTICS (FIG.13) JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH YAW	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	THIGH YAW	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.51

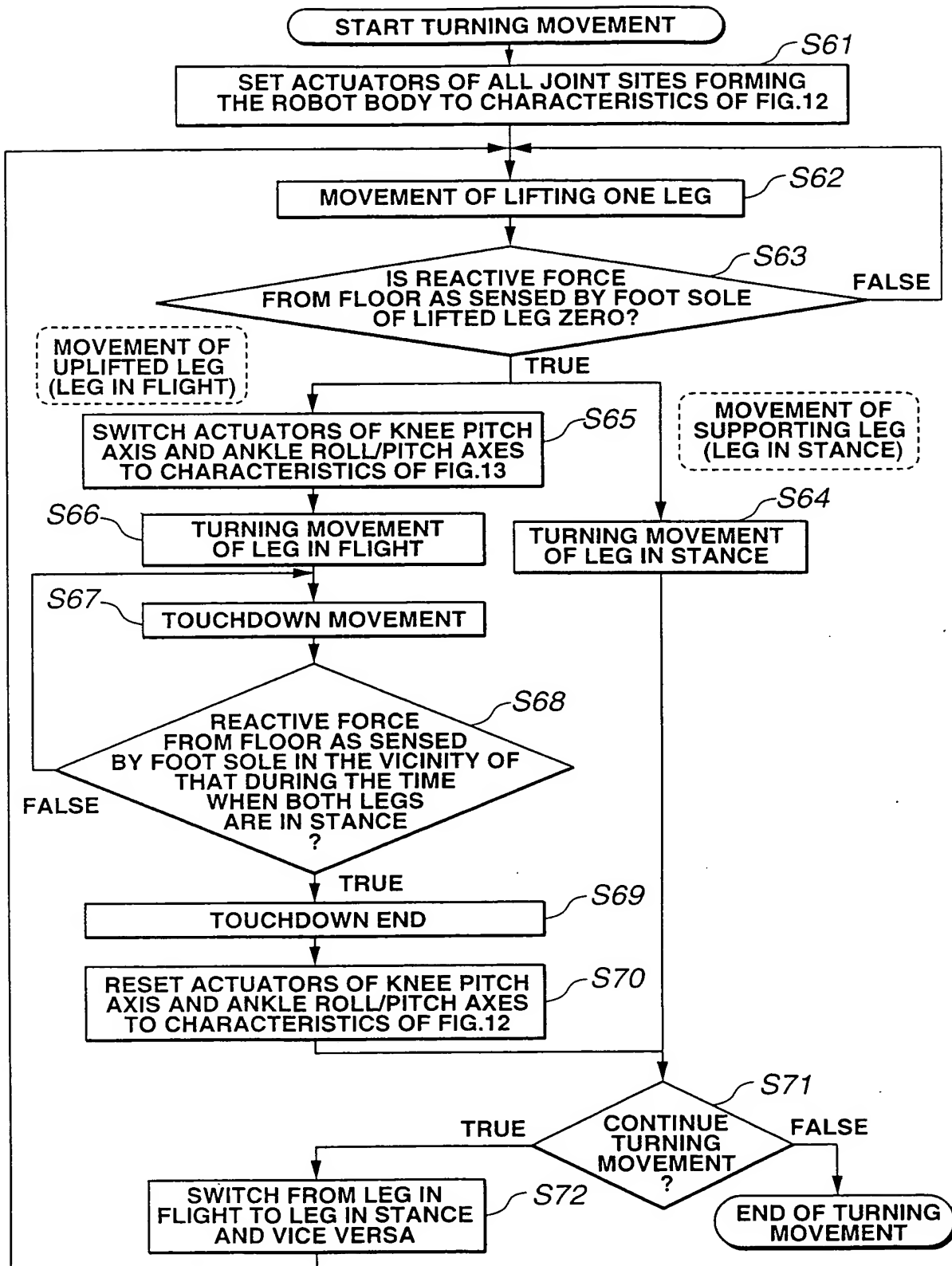


FIG.52